
SOURCE TEST REPORT

01-176

CONDUCTED AT

**Inland Empire Composting
1951 W. Key Street
Colton, CA 92324**

**REMOTE SENSING TESTS FOR AMMONIA AND VOLATILE ORGANIC
COMPOUND (VOC) EMISSIONS FROM A GREENWASTE COMPOSTING
OPERATION**

TESTED: November 30, 2001
December 5, 2001
December 6, 2001

ISSUED:

REPORTED BY: Mei Wang
Air Quality Engineer I

REVIEWED BY:

Michael Garibay
Senior Air Quality Engineer

MONITORING AND SOURCE TEST ENGINEERING BRANCH

MONITORING AND ANALYSIS

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
21865 E. Copley Drive, Diamond Bar, CA 91765

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Date: 11/30&12/5&12/6/2001

SUMMARY

- a. Firm and Mailing Address Inland Empire Composting
1951 W. Key Street
Colton, CA 92324
- b. Site Location 1951 W. Key Street
Colton, CA
- c. Area Tested Tipping Pile, Static Pile
- d. Test Requested by Alene Taber, Planning, (909) 396-3057
- e. Reason for Test Request Information for Proposed Rule 1133
- f. Date of Test November 30, December 5, and December 6, 2001
- g. Source Test Performed by Ron Lem, Mei Wang,
M. Garibay, C. Willoughby, Wayne Stredwick
- h. Test Arrangements Made through Jim Sullivan, Owner Inland Compost, (909) 689-7336
Wilson E. Nolan, CEO Inland Compost (909) 684-7336
- i. Field Technical Advisors Edwin Thornton, Boreal Laser, Inc. (780) 987-4382
Sung Kim, Optical Scientific, Inc. (301) 670-2100
Tim Scott, PE Systems, (714) 671-0660
- j. Test Observed by Brenda Smyth, California Integrated Waste Management
Board (CIWMB) (916) 319-7551, Greg Adams, County
Sanitation Districts Los Angeles County (CSDLAC) (562)
699-7411, Mark McDannel, CSDLAC (562) 699-7411,
Jesel Shah, CSDLAC (562) 699-7411, Dariush Vosoogai,
City of Los Angeles (310) 648-5127, Michael Miller,
City of Los Angeles (818) 834-5108
Elaine Chang, SCAQMD, (909) 396-3186
Alene Taber, SCAQMD, (909) 396-3057
Mary Woods, SCAQMD (909) 396-3094
- k. Flux Chamber Testing by Chuck Schmidt, Environmental Consultant
(530) 529-4256 (contracted by CIWMB and others)

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RESULTS

Table 1 – Winter Greenwaste Tests

	Tipping Pile (Tested on 11/30)		Static, Fines, and ADC Piles (Average of 12/5 and 12/6 Tests)		Windrows (data from Source Test Report # 01-171)		Facility Total
Contaminant	lb/hr per 1000 ft ² of Pile Surface Area	lb/hr	lb/hr per 1000 ft ² of Pile Surface Area	lb/hr	lb/hr per 1000 ft ² of Pile Surface area	lb/hr	lb/hr
Ammonia	0.018	0.73	0.048	3.01	0.004	0.33	4.07
Methane	0.20	8.18	0.048	3.02	0.005	0.41	11.6
VOC	0.28	11.6	0.21	13.5	0.079	6.45	31.6

- Surface Area Data – 41,309 ft² Tipping Pile, 63,458 ft² Static Pile, and 81,662 ft² Windrows.
- $\text{lb/hr} \cdot 1000 \text{ft}^2 = \text{lb/hr} / \text{Upwind Surface Area} \cdot 1000$
- $\text{lb/hr} = (\text{lb/hr} \cdot \text{ft}^2) \cdot (\text{Total Pile Surface Area})$
- $\text{ton/year} = \text{lb/hr} \cdot 24 \text{ hr} \cdot 365 \text{ day/year} \cdot \text{ton}/2000 \text{ lb}$
- $\text{lb/ton greenwaste} = (\text{lb/hr} \cdot 24 \text{ hr/day}) / 307 \text{ ton/day}$

Table 2 - Total Facility Emissions

Contaminant	lb/hr	lb/ton of Greenwaste
Ammonia	4.07	0.32
Methane	11.6	0.91
VOC	31.6	2.47

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Table 3 Method/ Technique Comparison for Static Pile on 12/6/2001

Type Method	NH3 (lb/hr-1000 ft2)	CH4 (lb/hr-1000 ft2)	VOC (lb/hr-1000 ft2)
Velocity/Laser/Spike	0.062	0.058	0.26
Laser/Spike Ratio	0.057	0.059	0.25
Flux Chamber	Not Available	0.060	0.27

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INTRODUCTION

On November 30, December 5, and December 6, 2001, personnel from the South Coast Air Quality Management District (SCAQMD), conducted source tests at Inland Empire Composting. The tests were conducted on two areas of Inland's processing: the tipping pile and static pile areas by using remote sensing measurement technologies. Emissions were measured at three different heights above the two processing areas. The wind velocities were also measured by two sets of sensors for north-south wind and west-east wind. The remote sensing technique differs from a typical source test in that it measures emissions in ambient air in the plume resulting from the process emissions as opposed to emission directly from the process.

The testing was requested by the SCAQMD Planning Division in order to help in development of Proposed Rule (PR) 1133 (Emission Reductions from Composting and Related Operations). Previously, the District only had an emission factor for digested sludge (biosolids) composting operations in the South Coast District. Inland Empire Composting suggested that a different emission factor should be used for green waste composting and volunteered their Colton facility for purposes of determining green waste emission factors. SCAQMD Source Test Engineers had conducted a source test at the same facility in late September of 2001 using the EPA Emission Isolation Flux Chamber approach. For results of that test, please refer to SCAQMD source test #01-171. In discussions in the PR1133 workshops, the September Flux Chamber tests have been referred to as the "Summer Test" while the testing presented in this report has been referred to as the "Winter Test". The remote sensing approach was chosen for the current test due to its larger scale measurement approach. The testing, however, yielded nearly identical VOC results, by either remote sensing or Flux Chamber.

The California Integrated Management Board (CIWMB) in cooperation with the County Sanitation Districts Los Angeles County (CSDLAC) and the City of Los Angeles Bureau of Sanitation contracted Flux Chamber expert Chuck Schmidt to conduct emissions sampling. The CIWMB testing was conducted at this and other greenwaste and greenwaste chip and grind facilities. Simultaneous testing was conducted by the SCAQMD by remote sensing and the CIWMB by Flux Chamber on the Inland Empire Static Pile on 12/6/01. While the results of this static pile comparison are presented in this report, the complete set of test results obtained by CIWMB are not presented in this report but may be obtained by contacting CIWMB.

The test results are to be used in evaluating emissions impact and the cost effectiveness of control techniques for SCAQMD PR1133. This issue has further significance when considering current diversion programs at local landfills. The current testing effort can also be used with the September test to evaluate effect of seasonal emissions variations.

EQUIPMENT AND PROCESS DESCRIPTION

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Composting is a natural biological degradation process that is controlled and accelerated at a composting facility. Under ideal conditions, composting is the transformation of biologically decomposable material through a controlled process of biooxidation that results in the release of carbon dioxide, water, and minerals, and in the production of stabilized organic matter (compost) that is biologically active.

The composting process occurs in two major phases. In the first stage, microorganisms decompose the feedstock into simpler compounds, producing heat as a result of their metabolic activities. The size of the composting pile is reduced during this stage. In the second stage, the compost product is “cured” or finished. Microorganisms deplete the supply of readily available nutrients in the compost, which in turn slows their activity. As a result, heat generation gradually diminishes and the compost becomes dry and crumbly in texture. When the curing stage is complete, the compost is considered “stabilized” or “mature”. Any further microbial decomposition will occur very slowly.

During the actual composting process, bacteria are generally allowed to decompose the mixture in a combination of aerobic and anaerobic activity. Airborne by-products of the anaerobic activity, which are largely reduced compounds, include relatively large amounts of methane, hydrocarbons, ammonia, and relatively smaller amounts of amines, hydrogen sulfide, and other reduced sulfur compounds. The anaerobic activity is less desirable due to emissions of toxic and odor-causing compounds. Fugitive dust can be a direct source of PM-10 emissions, particularly during periods of high temperatures, high wind, and low humidity.

The heat generated by the exothermic reaction raises the compost's internal temperature to 120-160°F. The heat also serves the purpose of reducing pathogenic activity. The compost composition is thought to have an impact on emissions since the process is dependent on microbiological activity and oxygen availability.

The following is a list of operating conditions that were encountered during the testing:

Greenwaste Throughput - 307 ton/day (December daily average)

Tipping Pile Age - 2 days from arrival at facility

Static Pile Age – 8-9 days in static pile (10 - 16 days total at facility)

Windrow Ages – refer to Figure A in Appendix and Calculation section)

Pile Dimensions - (refer to Figure A in Appendix and Calculations section)

Compost Composition - (refer to compost analysis in Appendix)

The composting process at the facility can be characterized by the following process flow diagram (Figure 1). Photographs of the tipping and static piles are shown in Pictures 1 and 2.

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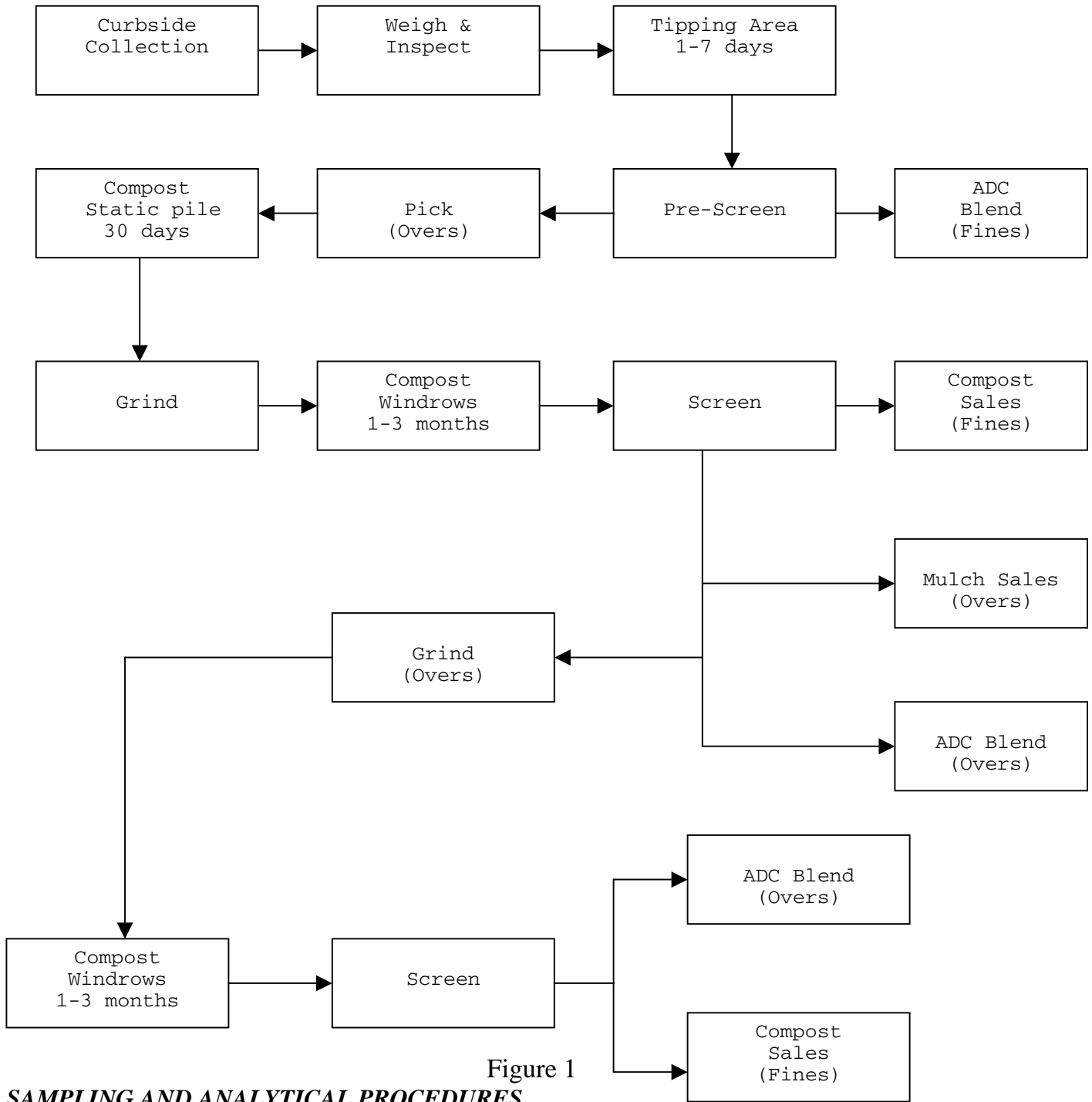


Figure 1

SAMPLING AND ANALYTICAL PROCEDURES

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The source test was conducted over a plane perpendicular to the compost surface and perpendicular to the wind direction and across the top of each pile/area through which it was determined that the upwind portion of the pile/area's emissions pass. A depiction of this scheme is shown in Figure 2. Two techniques were combined to measure the emissions resulting in the emissions plume from the compost operations as opposed to the emissions from the compost surface. This source test was mainly conducted by using remote sensing (Boreal Laser) measurement technology for ammonia and methane. An Optical Scintillation flow rate device was used to measure and record the wind directions and velocities. Flux chamber sampling results were used to provide a methane to VOC ratio. The resulting measurements for mass emissions were checked for accuracy by using a spiking technique which is depicted in Figure 2 and in Picture 3.

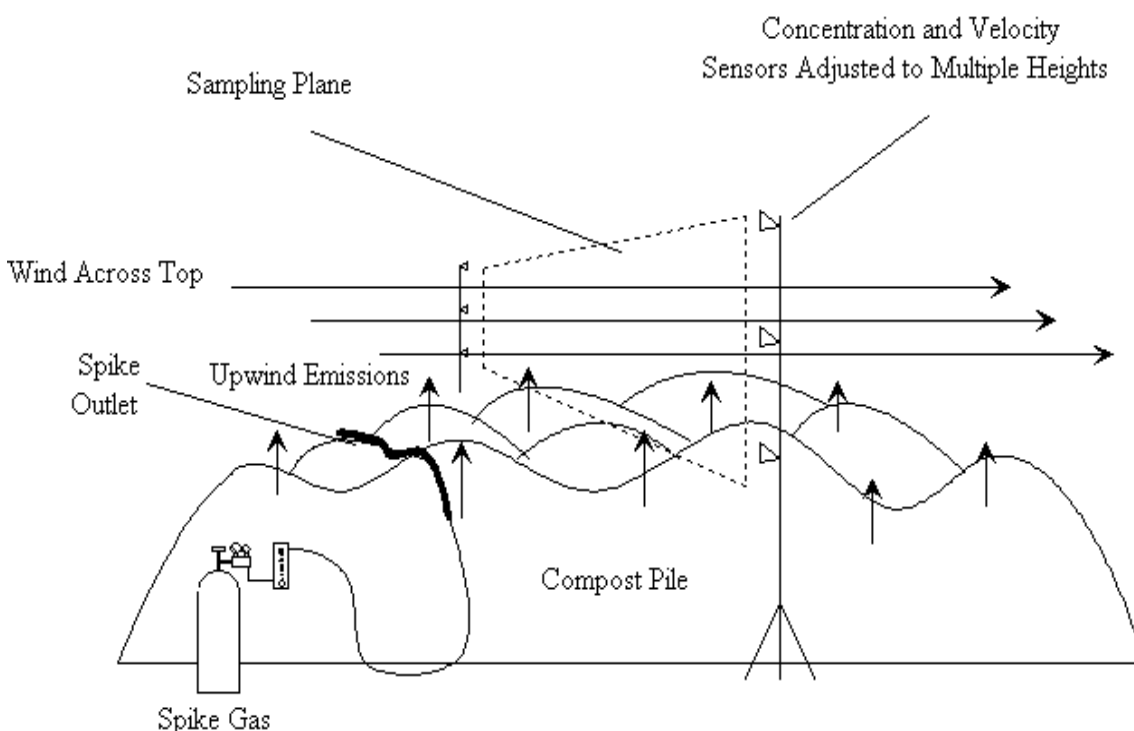


Figure 2 - Sampling Technique

Boreal Gas Finder

The Boreal Laser has an open-path monitor that measures methane and ammonia concentration over an open path which consists of an integrated transmitter/receiver unit and a remote, passive retro-reflector array. The two-axis instrument mount is assisted by a telescopic sight and an on-board visible aiming laser initially to target the remote retro-reflector.

The transceiver houses the laser diode source, drive electronics, detector module, and microcomputer subsystems. Also included is a calibration reference cell which contains an actual sample of the measured gas through which the instrument performs automatic self calibration. The transceiver unit is contained in a weatherproof enclosure and has connectors for power input and data I/O. A schematic representation of the Gas Finder system is shown in Figure 3. A photograph of the Gas Finder is shown in Picture 4.

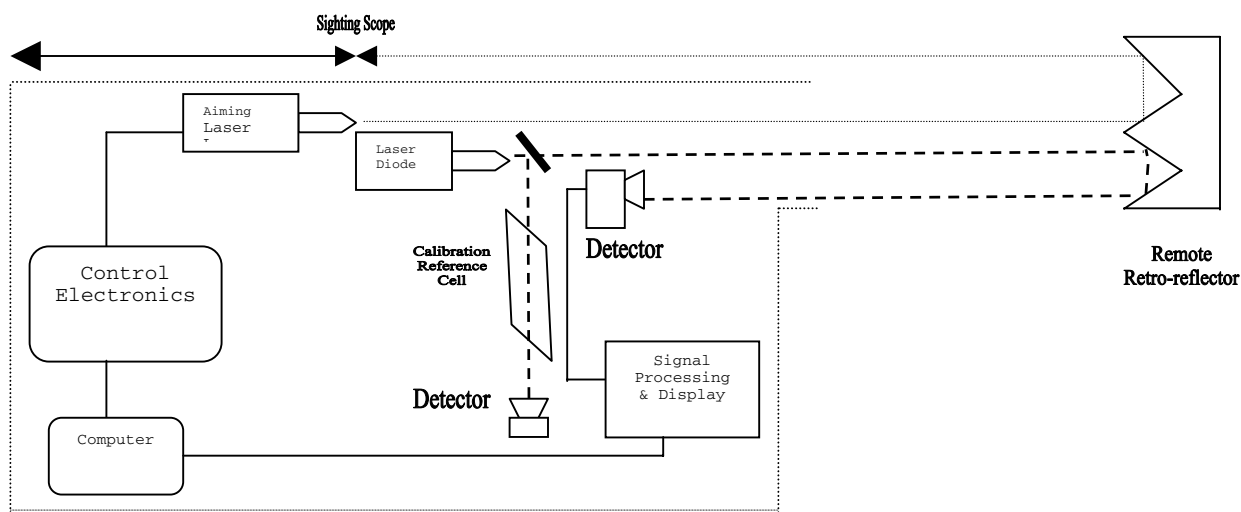


Figure 3 Gas Finder System

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The laser light emitted from the transceiver unit propagates through the atmosphere to the retro-reflector and returns where it is focused onto a photodiode detector. Simultaneously, a portion of the laser beam is passed through the onboard reference cell to provide a continuous calibration update. These two optical signals are converted into electrical waveforms which the micro-controller processes to determine the actual concentration of the gas alone from the optical path. The computed gas concentration is then displayed on the back panel of the instrument as well as being transmitted to a laptop computer where the data is collected, stored and displayed.

Results are shown as concentration in ppm (Tables 4-1 and 5-1) on the display and the emission rates are calculated in lb/hr-1000ft² of surface area (Tables 4-2 and 5-3). The final mass emission rates are reported on a facility wide basis using the entire compost surface area within the facility for the two types of piles that were tested plus the emission rate from the windrow piles using the emission factor measured in source test report 01-171 (Tables 4-3 and 5-3).

Optical Scintillation Flow Rate Device

To calculate the emission rate, wind velocities are required. The Optical Scintillation Flow Rate Device was used to measure wind velocities and directions in this test. The sets of Optical Scintillation Flow Rate Devices contain two channels each which have a receiver, transmitter, and a computer. Channel one recorded north-south wind and velocities and channel two recorded west-east wind and velocities. A photograph of the optical scintillation flow rate device is shown in Picture 4. The resulting wind vectors were then used in calculating the mass emission rates (Tables 4-1 and 5-1). This flow device is ideal for use with the Boreal Lasers due to the similar linear path averaged measurement approach.

Sampling Locations

Three emission concentrations were taken at three linear paths above the tipping and static piles. The sampling planes were created by combining the three linear heights. The sampling planes were created for calculating the mass emission rates. Both laser and optical scintillation flow devices were set on top of a tripod. The planes were created by raising or lowering the linear path or the laser instrument

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on tripods located across the top on the compost pile (Figure 4). The lower and upper boundaries of this plane were defined as the heights when the resulting concentration reached near background levels (see *Test Critique*). Background levels were determined upwind of the pile prior to testing the actual pile.